ASLEEP AT THE WHEEL

A NATIONAL COMPENDIUM OF EFFORTS TO ELIMINATE DROWSY DRIVING

U.S. Department of Transportation
National Highway Traffic Safety Administration

NHTSA

CONTENTS

BACKGROUND TO THE ISSUE

Fatigue has costly effects on the safety, health, and quality of life of the American public. Whether fatigue is caused by sleep restriction due to a new baby waking every couple of hours, a late or long shift at work, hanging out late with friends, or a long and monotonous drive for the holidays – the negative outcomes can be the same. These include impaired cognition and performance, motor vehicle crashes, workplace accidents, and health consequences. Addressing these issues can be difficult when our values frequently do not align with avoiding drowsy driving. In a 24/7 society, with an emphasis on work, longer commutes, and exponential advancement of technology, many people do not get the sleep they need.[1] Effectively dealing with the drowsy-driving problem requires fundamental changes to societal norms and especially attitudes about drowsy driving.

Drowsy-driving crashes can happen any time, but most frequently occur at night in the early pre-dawn hours or in the mid-afternoon. Age also plays a significant factor. Research conducted in 2012 by the AAA Foundation for Traffic Safety shows that crash-involved drivers 16 to 24 years old were nearly twice as likely to be drowsy at the time of the crash compared to drivers 40 to 59 years old. Drivers 24 and younger were most likely to report having fallen asleep at the wheel in the past year. These results are consistent with multiple independent studies on this topic.

Unfortunately, determining a precise number of crashes, injuries, and fatalities caused by drowsy driving is not yet possible. Crash investigators can look for clues that drowsiness contributed to a crash, but these clues are not always identifiable or conclusive. NHTSA's census of fatal crashes and estimate of traffic-related crashes and injuries rely on police and hospital reports to determine the incidence of drowsy-driving crashes. NHTSA estimates that in 2015, over 72,000 police-reported crashes involved drowsy drivers. These crashes led to 41,000 injuries and more than 800 deaths. However, there is broad consensus across the traffic safety, sleep science, and public health communities that this is an underestimate of the impact of drowsy driving.

The broader community's best estimate of drowsy-driving crashes is that 7 percent of all crashes and 16.5 percent of fatal crashes involve a drowsy driver. This estimate suggests that approximately 6,000 people died in drowsy-driving-related motor vehicle crashes across the United States last year. This study performed by the AAA Foundation for Traffic Safety (Tefft, 2012) used a statistical multiple imputation process to estimate drowsy driving incidence in the NHTSA NASS Crashworthiness Data System (CDS). Some researchers feel this may still be an underestimate and that there may be more than 8,000 deaths attributable to drowsy driving each year.

While estimates differ on the exact incidence of drowsy driving, we can all agree it is a critical traffic safety issue that leads to thousands of deaths each year and causes an estimated $109 billion of societal harm.[2] A 2002 NHTSA-sponsored Gallup survey showed that 95 percent of the driving population considered drowsy driving to be a major threat to their safety. AAA's 2014 Traffic Safety Culture Index also showed drivers consider it unacceptable for people to drive when they are so sleepy that they have a hard time keeping their eyes open. Despite these findings, more than 1 in 4 drivers (29.4%) reported having driven when they were so tired that they had a hard time keeping their eyes open in the past 30 days. One in five (19.8%) reported having done this more than once, and 2.4 percent reported having done this fairly often or regularly.

1 Watson, N.F., et al. (2015). Recommended Amount of Sleep for a Healthy Adult: A Joint Consensus Statement of the American Academy of Sleep Medicine and Sleep Research Society. *Sleep, 38*, 1161-1183.
2 Higgins, J.S., et al. (In Press). Asleep at the Wheel – The Road to Addressing Drowsy Driving, *Sleep*.

HOW WE GOT HERE

Over the last two decades, public and private organizations have made a number of attempts to address drowsy driving. These efforts have included stakeholder meetings, public information campaigns, development of detection and alerting technology, fatigue management programs in a limited number of workplaces, and passage of State laws. These programs, technologies, and laws aim to contribute in varying degrees to reducing drowsy driving. However, strategies that effectively address attitudes about fatigue among the general driving public are lacking.

The traffic safety community has been successful in developing effective methods to change behavior related to drinking and driving, seat belt use, and a number of other safety risks, but has been unable to mitigate drowsy driving in an effective, widespread and organized manner. Meanwhile, the sleep science community has long recognized the dangers of drowsy driving but has lacked access to the required resources for achieving nationwide change. In order to change the national conversation on drowsy driving, stakeholders from both the traffic safety and sleep science communities are working together on a broad array of actions and activities.

NHTSA convened the forum "Asleep at the Wheel: A Nation of Drowsy Drivers" on November 4 and 5, 2015, during the National Sleep Foundation's National Drowsy Driving Prevention Week. This meeting included more than 100 participants from many diverse organizations, setting the stage for a national coordinated effort by bringing together motor vehicle and highway safety experts with sleep/circadian science experts and the sleep medicine community. NHTSA sought to establish a partnership in which years of unique knowledge and experience could be combined to effectively address the challenge of eliminating drowsy driving.

The forum resulted in a matrix of long- and short-term actions and ideas by the various stakeholders. In this compendium, the matrix has been collapsed into a set of successful efforts and novel ideas organized across topics including research and development, public and private partnerships, public education and awareness, and vehicle technology.

Within each topic area, the challenges to more effectively combat drowsy driving are identified. The compendium also features the various efforts that contributors are taking to address each of these challenges.

RESEARCH AND DEVELOPMENT

- Expand and share crash risk research using converging methodologies (e.g., naturalistic, case-control studies, crash investigations, mobile technologies)
- Improve crash reporting
- Document the economic impact of drowsy driving
- Research and develop new methods for detecting fatigue and sleep restriction (e.g., biomarkers)

PARTNERING WITH PUBLIC AND PRIVATE STAKEHOLDERS

- Evaluate effectiveness of new and existing laws
- Evaluate effectiveness of corporate fatigue-management policies
- Develop fatigue-risk-management programs for high-risk professions such as EMS and public safety
- Explore potential of graduated driver licensing (GDL) laws for reducing drowsy driving
- Facilitate regular engagement of the sleep science community with corporations and the insurance industry
- Provide technical assistance for State policy and program actions based on identified problems

PUBLIC EDUCATION AND AWARENESS NEEDS

- Develop new education and awareness campaign material
- Promote integration into driver licensing manuals and exam questions
- Examine the effectiveness of education efforts in New Jersey and Arkansas regarding existing laws to affect social norms
- Conduct broad public health campaign on sleep and health
- Promote corporate wellness programs

VEHICLE TECHNOLOGY NEEDS

- Promote research and development of drowsiness detection, alerting, and vehicle response systems
- Educate consumers on use of new vehicle technology that will help prevent drowsy-driving crashes
- Encourage adoption of collision avoidance technologies

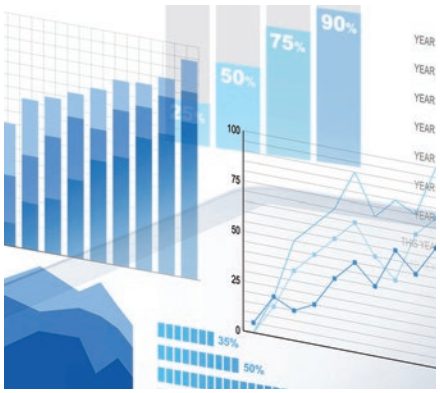
ORGANIZATIONS

A wide variety of public, private, for-profit, and not-for-profit organizations have come together to contribute to this national effort to address drowsy driving:

- American Academy of Sleep Medicine (AASM)
- Centers for Disease Control and Prevention (CDC)
- Faurecia S.A.
- Federal Aviation Administration (FAA)
- Governors Highway Safety Association (GHSA)
- U.S. Food and Drug Administration (FDA)
- General Motors
- Honda
- Insurance Institute for Highway Safety (IIHS)
- State of Iowa
- University of Michigan Transportation Research Institute (UMTRI)
- National Association of State Emergency Medical Services Officials (NASEMSO)
- National Highway Traffic Safety Administration (NHTSA)
- National Safety Council (NSC)
- National Sleep Foundation (NSF)
- Network of Employers for Traffic Safety (NETS)
- Sleep Research Society (SRS)
- Start School Later, Inc.
- Westat, Inc.

RESEARCH AND DEVELOPMENT

Addressing drowsy driving requires a better understanding of the overall prevalence of the problem and who is at risk. With this information, the community is better able to prioritize research, programs, and messaging to most efficiently address the issue. Prevention efforts can also be tracked with appropriate data. However, the biggest challenge is the inability to collect reliable and valid drowsy-driving crash data that provides a true count, or a sound estimate, of the extent of the problem. The community will need to continue its current research as well as develop new technologies and methods to more effectively address gaps in the current state of knowledge.



QUANTIFYING DROWSY DRIVING

The largest and most comprehensive naturalistic driving study to-date, the second Strategic Highway Research Program (SHRP2), was conducted by the Transportation Research Board from 2005 to 2016 and collected data at sites across the United States with varying geographic locations, both urban and rural roads, climate variation, and regional differences in transportation practices. The data set contains approximately 3,900 driver years from participants who ranged from 16 to 80 years old, with an estimated total of 2.5 million trip files. SHRP2 data offers an unparalleled view into the relationship between drowsy driving and crash risk. NHTSA is currently funding research with Westat, Inc., the University of Iowa, and the University of Wisconsin to explore drowsy driving in the SHRP2 data set. NHTSA hopes to better characterize the relationship between drowsy driving and crash risk and driver-critical reasons for crashes and near misses; understand variables that may help identify drowsy drivers in other data sets (e.g., FARS); and identify individual differences that predict the likelihood of drowsy driving.

NATIONAL SURVEY OF DROWSY DRIVING KNOWLEDGE, ATTITUDES, AND BEHAVIORS

To better understand public knowledge, attitudes, and drowsy-driving behaviors, NHTSA is funding a survey to provide national estimates of drowsy-driving knowledge, attitudes, and behaviors. NHTSA is also exploring these topics in New Jersey and Arkansas, the two States with drowsy-driving laws. Understanding the public's attitudes and awareness is an important step in designing and deploying education and other countermeasures that will affect the incidence of drowsy driving across the United States.

Beyond a national survey, collecting statewide drowsy-driving data provides a powerful spotlight on the prevalence of drowsy driving within a State. Iowa posed drowsy-driving questions to people waiting in line at five different driver licensing stations as part of a statewide public awareness and attitude survey. Other States may explore how they too can better understand the attitudes and behaviors of their drivers.

DROWSY-DRIVING DATA COLLECTION AND REPORTING BY LAW ENFORCEMENT

There is little information on whether and how law enforcement officers identify drowsy drivers, or how often they encounter drowsy drivers while on patrol. This information would be useful, both in estimating the magnitude of the problem and possibly in developing reporting protocols and training for law enforcement. To supplement ongoing data-collection initiatives, NHTSA is working with law enforcement officials to gauge drowsy driving encountered during routine contacts (stops, assists, crashes, etc.) with drivers. A reporting protocol for drowsy driving and training may be developed as well.

Including "drowsy or fatigued" under contributing factors or driver's condition in crash reports would help States better understand the scope of the problem. Iowa crash reporting forms did not include this factor until their last crash report update. Since it was added, the State has seen an increase in drowsiness being identified as a factor in crashes.

DRIVER PHYSICAL FACTORS LEADING TO UNINTENTIONAL LANE-DEPARTURE CRASHES

Researchers from the Insurance Institute for Highway Safety (IIHS) examined data from the National Motor Vehicle Crash Causation Study to determine the role that physical factors play in lane departures. The analysis shows that as many as 34 percent of lane-drift crashes – 42 percent of those with serious or fatal injury – involve drivers whom investigators coded as incapacitated, with about half of that number attributed to sleeping. The other half were incapacitated due to illness or blacked out from drug or alcohol use.

BEHAVIORAL RISK FACTOR SURVEILLANCE SYSTEM

The Centers for Disease Control and Prevention's (CDC) drowsy-driving activities are conducted by the Sleep and Sleep Disorders Team of the National Center for Chronic Disease Prevention and Health Promotion.
The Team works to increase awareness of sleep health and sleep disorders and their impact on the public's health. The Team maintains a drowsy-driving webpage.

The Sleep and Sleep Disorders Team developed and implemented new sleep questions for CDC's public health surveillance systems including the Behavioral Risk Factor Surveillance System (BRFSS), the world's largest, ongoing telephone health survey system that tracks health conditions and risk behaviors in the United States.

The BRFSS's drowsy-driving findings have been published in the CDC's Morbidity and Mortality Weekly Report. BRFSS maintains a website with information on the sleep-related questions that have been included on the CDC's surveys.

SLEEP IN AMERICA POLL

The National Sleep Foundation (NSF) has conducted its annual Sleep in America poll since 1991 to survey Americans' attitudes, opinions and knowledge in regard to sleep health. NSF also surveys Americans on a quarterly basis on their Sleep Health Index (SHI) regarding trends in sleep. The SHI includes a fixed set of questions on drowsy driving.

CRASH AVOIDANCE SYSTEMS DATA ANALYSIS

Ongoing research by IIHS and the Highway Loss Data Institute (HLDI) is investigating the real-world effectiveness of collision avoidance systems. Front crash prevention has been shown to be effective in reducing front-to-rear crashes. Vehicles with front crash prevention systems have fewer claims under property damage liability coverage, which pays for damage to vehicles that an at-fault driver hits. Systems with forward collision warning and automatic braking cut police-reported rear-end crashes in half, while forward collision warning alone reduces them by 27 percent. HLDI has examined blind-spot-monitoring systems from seven manufacturers. Six systems have reduced rates of claims for damage to other vehicles. Although these systems do not directly target drowsy drivers, they have the potential to help drowsy and distracted drivers avoid a crash.

Research has shown few insurance-claim benefits so far for lane departure warning, although there is some evidence that police-reported head-on and run-off-road crashes with injuries have been reduced. Unfortunately, the same analyses show some tradeoff in an increased number of side-swipe crashes with injuries. These conclusions apply only to lane departure warning systems and not systems that act to prevent lane departures or to ensure lane following. The first results of this project were published in 2011, and updates continue.

Other efforts are being proposed by a consortium of General Motors and the University of Michigan Transportation Research Institute. This research effort seeks to perform a large-scale study of driver drowsiness, associated driving behavior, and safety implications. This study will include vehicles with driver assistance systems (e.g., Lane Keep Assist, Lane Departure Warning, Forward Collision Alert) that can be assessed with respect to driver sleep history in order to shed light on prevalence and patterns of drowsy driving and the extent to which these driver assistance systems may be mitigating the substantial number of crashes, injuries, and fatalities associated with drowsy driving.

NHTSA recently performed a basic analysis of the societal impact of drowsy driving. The current estimate of the associated societal costs of drowsy driving is $109 billion per year, based on a 2010 NHTSA report on the societal costs of motor vehicle crashes. This estimate only takes into account crashes in which at least one person was hospitalized or killed. This does not account for the many property-damage-only crashes related to drowsy driving.

BIOMARKER DEVELOPMENT

With major scientific and technological advances in neuroscience, the biomolecular mechanisms underlying drowsiness are increasingly well understood, and the establishment of a panel of biomarkers for drowsiness is within reach. The Sleep Research Society (SRS), as part of an international collaboration with other sleep and circadian science organizations, is at the forefront in supporting biomarker development for sleep deficiency, circadian misalignment, and drowsiness. Specifically, the SRS is supporting: (1) international meetings and workshops to bring stakeholders together; (2) development of research definitions and experimental standards for drowsiness biomarker studies; (3) workshops on high-throughput sleep/circadian phenotyping to enable biomarker studies; and (4) training of sleep and circadian scientists to conduct biomarker studies.

The Federal Aviation Administration (FAA) is also working toward a test to detect fatigue through gene expression biomarkers. While crash prevention is the higher aim, FAA hopes to apply biomarker detection of fatigue in crash investigations. This project was started in 2011 and is envisioned to continue until available resources and capable workforce are sufficient, nationally and internationally, to make the development of a biomarker panel of drowsiness a reality.

APPROACHES TO ADDRESS DROWSY DRIVING

To motivate behavior change, policies and laws have proven to be effective tools in highway safety programs when combined with appropriate education efforts. Not only can laws and policies provide a system where an inappropriate and dangerous behavior is discouraged, but they can also communicate appropriate societal norms.

DROWSY DRIVING AT WORK

One of the most recognizable causes of fatigue is career-related. Motor vehicle crashes, on and off the job, cost employers nearly $50 billion in 2013. Many of these were likely due to fatigue. These numbers do not account for the substantially larger cost of all injuries on the job or other costly workplace mistakes leading to lost time and productivity or lawsuits. Fatigue may play a significant role in these workplace incidents and cost businesses billions of dollars annually. Addressing the root causes of sleep restriction or dangerous levels of fatigue can lead to more efficient and safer work practices, as well as less drowsy driving both at work and on the way to/from work. Providing employers with methods to address drowsy driving and workplace fatigue will not only improve their bottom lines, but positively affect road safety.

HELPING EMPLOYERS ADDRESS DROWSY DRIVING AT WORK

Through policies, awareness and information, employers are able to reach a large portion of the driving population in the United States, and even more when the outreach includes family members and community members. Each year, the Network of Employers for Traffic Safety (NETS) sponsors Drive Safely Work Week and produces a toolkit on a specific theme for the week. In 2016, NETS developed a Drive Safely Work Week toolkit focusing on the dangers of drowsy driving. NETS produced two additional documents that help employers address drowsy driving: NETS's Comprehensive Guide to Road Safety™ and NETS's Recommended Road Safety Practices.™ Register for free access to these and other NETS resources at http://trafficsafety.org/registration.

In addition to recently developed material, NETS, the Volpe National Transportation Systems Center, and the National Institute for Occupational Safety and Health (NIOSH) have assembled a team to develop material about fatigue and drowsy driving. The objective is to publish a series of free, brief and actionable documents for use by employers.

The National Safety Council (NSC) is also heavily involved in employer programs and education to address drowsy driving (and workplace fatigue in general). NSC is working to develop a fatigue cost calculator. This calculator will bring awareness to the cost of fatigued employees in terms of decreased productivity and safety incidents. The calculator will allow employers to look at costs by industry, including but not limited to the transportation industry. In 2017, the National Safety Council (NSC) is planning to release a fatigue toolkit of educational resources and model policies for employers. The kit will include sample policies to address risks such as drowsy driving. The collection of policies will allow employers to quickly adopt policies with ready-to-launch material.

Our Driving Concern (ODC): Employer Traffic Safety Program, a program of the National Safety Council in cooperation with the Texas Department of Transportation, provides necessary traffic safety information to keep employees safe on Texas roads. ODC provides free traffic safety information, resources, and training to equip employers in addressing traffic safety in the workplace. Drowsy driving, distracted driving, impaired driving, passenger restraint, aggressive driving, and other important traffic safety topics are addressed in the ODC program. Free and ongoing support to and for employers include Huddle Sheets, a mobilized website, webinars and mini-webinars, train the trainer, talking points, and safety coach and educational material. This program expanded to the State of Oklahoma in 2016.

FATIGUE TRAINING AND INTERVENTION RESEARCH

A number of organizations involved in developing this compendium are involved in fatigue management training program research and development. One excellent example is recent research performed at the John A. Volpe National Transportation Systems Center. Volpe explored the effectiveness of training programs designed to reduce the effects of drowsiness. The research showed that drowsiness decreases critical hazard anticipation, hazard mitigation, and attention maintenance skills in nurses involved in shift work. The most exciting finding was that a Volpe-developed training program was able to successfully reduce the effects of drowsiness. Volpe is continuing this research and plans to extend it to other populations.

FATIGUE RISK MANAGEMENT GUIDELINES FOR EMERGENCY MEDICAL SERVICES

NHTSA, the National Association of State EMS Officials (NASEMSO), and the University of Pittsburgh Medical Center are working to improve awareness and eliminate hazards related to drowsy driving in high-risk professions through the development of Evidence-Based Fatigue Risk Management Guidelines for Emergency Medical Services. This partnership is working to systematically review, synthesize, and grade the quality of evidence related to the measurement and effect of fatigue among EMS personnel; the relationship of shift work and fatigue; effective fatigue countermeasures; sleep and rest strategies to mitigate fatigue; enhanced fatigue education and training; the use of statistical models to mitigate fatigue; and the relationship of workload to fatigue. Additional background material is available.

COMMERCIAL MOTOR VEHICLE OPERATORS AND RAIL WORKERS

In March 2016, the U.S. Department of Transportation's (DOT) Federal Motor Carrier Safety Administration (FMCSA) and Federal Railroad Administration (FRA) requested public input on the impacts of screening, evaluating and treating rail workers and commercial motor vehicle operators (CMVO) for obstructive sleep apnea (OSA). The joint Advance Notice of Proposed Rulemaking was the first step as both agencies consider whether to propose specific requirements. The American Academy of Sleep Medicine submitted a response to the FMCSA and FRA proposal and attended the FMCSA Medical Review Board (MRB) hearing on August 22-23, 2016.

LEGISLATION AND ENFORCEMENT

Currently there are only two States with laws that expressly codify the punishment of drivers involved in drowsy-driving crashes: Arkansas and New Jersey.

CURRENT STATE LAWS

Two States have enacted laws specifically addressing drowsy and fatigued driving, while others have used broader statutes (e.g., reckless or careless driving) as a means for controlling this behavior. NHTSA is working to determine how the laws are enforced, as well as exploring the potential of conducting awareness and prevention programs in these States. Researchers at the University of Maryland are working to understand and document the legislative successes and challenges around the Nation. In addition, NHTSA is investigating drowsy-driving legislative activity in other States and documenting successes or obstacles encountered.

FUTURE STATE LAWS

The National Sleep Foundation is working with its members and partners, such as Start School Later, Inc., to support public advocacy of drowsy driving prevention at the State level by creating a Drowsy Driving State Advocacy Toolkit as well as model State legislation. These efforts are designed to motivate and empower citizens and State legislators to increase State legislative action on drowsy driving prevention.

Teen drivers are among the most at risk when it comes to drowsy driving, and stakeholders are taking varied approaches to address that risk. For example, both graduated driver licensing (GDL) and school start times represent important factors impacting teen health and safety. Through GDL programs, every State, except Vermont, restricts the nighttime hours that young, inexperienced drivers may drive without adult supervision (11 p.m. to 5 a.m., for example). It is also important to give teens enough time to get sufficient sleep before school. Organizations such as Start School Later, Inc. are working toward ensuring that students get the sleep they need to be happy, healthy, and safer drivers.

LAW ENFORCEMENT

There is little information on how law enforcement officers identify drowsy drivers, or how often they encounter a drowsy driver while on patrol. This information would be useful both in estimating the magnitude of the problem and in developing reporting protocols and training for law enforcement. NHTSA recently started a project to further explore this issue.

To address the large number of crashes involving commercial motor vehicles, the Iowa State Patrol partnered with FMCSA to provide additional training to troopers. The Iowa State Patrol plans to expand this training opportunity to county and local officers in the future.

HIGHWAY SAFETY IN THE STATES

The Governors Highway Safety Association (GHSA) recently released a report on drowsy driving, *Wake Up Call! Understanding Drowsy Driving and What States Can Do*. The report highlights just a few of the innovative and creative State efforts to address drowsy driving.

NHTSA's Highway Safety Program provides direction to State Highway Safety Offices for the formulation of their highway safety plans, which identify highway safety problems and countermeasures to address those problems. Problem identification and countermeasures are quite mature for several highway safety issues, such as impaired driving, occupant protection, pedestrian and bicycle safety, speed management, and emergency medical services, among others. However, effective approaches to address issues such as drowsy and distracted driving are still in development. While much progress has been made, more work is needed.

U.S. DOT is working to disseminate information and increase awareness among roadway and traffic safety decision-makers of the potential role of rumble strips in

addressing drowsy-driving risks. For example, roadway rumble strips have proven to be particularly cost-effective in reducing crash types that are associated with drowsy and distracted driving. Installation of rumble strips is inexpensive compared to other infrastructure improvements (about $1,000-$5,000 per mile). Evaluations indicate that rumble strips can reduce lane departure crashes by 50 percent or more depending on location. NHTSA and FHWA are working together to promote widespread adoption of rumble strip technology.

PUBLIC EDUCATION AND AWARENESS

An important step in changing drowsy-driving behavior is ensuring that people understand the related risks, behavioral signs, and appropriate countermeasures. With this knowledge, people have the basic tools to make better decisions about their own behavior. This is only part of the formula, though. People need to be convinced to use this knowledge and change their behavior. NHTSA's experience with other safety behaviors, including seat belt use, drinking and driving, and driver distraction, indicates that awareness and knowledge alone will not yield sufficient change. However, public education is a necessary program component, along with policy development and enforcement. A diverse range of public awareness and education efforts across a broad range of related topics are highlighted below. Also highlighted are an increasing number of meetings and forums being held on the topic that foreshadow many future efforts across partners.

PUBLIC MEETINGS

THE IOWA DROWSY DRIVING SUMMIT

The Iowa Department of Public Safety's (DPS) Iowa Governor's Traffic Safety Bureau (GTSB) co-hosted the first-in-the-Nation statewide Drowsy Driving Summit in Iowa City on June 29, 2016. The summit was designed to increase public awareness of the drowsy-driving issue. Current research on education, enforcement, and engineering prevention strategies was highlighted. Additionally, a PSA designed to increase public awareness of drowsy driving (developed by GTSB and The Integer Group) was released.

SLEEP HEALTH AND SAFETY: TAKING CONTROL OF OUR ROADWAYS

IIn 2015, as part of its conference, Sleep Health and Safety: Taking Control of Our Roadways, the NSF declared its commitment to collaborate with all stakeholders in roadway safety to help prevent drowsy driving; NSF is eager to work with industry on education, technical standards in regard to driver vigilance, and alertness and safety, as well as to organize cooperative ventures among other stakeholders toward public awareness and an end to drowsy-driving-related deaths.

FATIGUE BLUE RIBBON PANEL

On December 13, 2016, NSC held the Fatigue Blue Ribbon Panel in Chicago, Illinois, to bring together fatigue researchers and industry safety professionals to discuss the scope of the problem, share knowledge, explore collaborations, and help identify potential solutions. This panel focused on addressing fatigue both in the workplace and on the roads.

NATIONAL CONFERENCE ON TEEN SLEEP AND SCHOOL START TIMES

In collaboration with the RAND Corporation, researchers from Harvard Medical School/Boston Children's Hospital and others, Start School Later is planning a national conference to be held April 27-28, 2017, in Washington, DC. Early school start

times are widely recognized as a major contributor to both teen sleep deprivation and to drowsy driving among teenagers. This national conference aims to provide educational policymakers and advocates with practical guidance that includes clear implementation guidelines for school districts that often struggle in relative isolation to implement this policy change, as well as a forum for sharing ideas and networking.

MANAGING FATIGUE

In March 2017, 10th Annual International Managing Fatigue Conference is being held in in San Diego, California, in 2017. The "Managing Fatigue" conference series is a distinguished forum for the presentation of research and formative discussions within the fatigue management community. Each conference has focused primarily on fatigue in the transportation industry with support from government, industry, and academia. Recent iterations of the conference have begun focusing beyond transportation to include mining, healthcare, and the military.

EDUCATION AND AWARENESS PROGRAMS

IOWA

The Iowa Department of Transportation utilizes electronic variable message signs along State interstate systems to post traffic safety messages weekly, commonly referred to as "Message Mondays." Messages specific to drowsy driving have been displayed throughout the year, such as "Give It a Rest, Don't Drive Drowsy" and "Drowsy? Crash on a Couch Not a Road." The Iowa Department of Transportation plans to continue using drowsy-driving messages in this initiative. Other efforts to educate the public on the dangers of drowsy driving include presentations by the Iowa State Patrol at schools, businesses and service/community organizations.

The Governor's Traffic Safety Bureau partnered with Hy-Vee Supermarket in a public awareness campaign to help spread the word about drowsy driving through the development and distribution of bag stuffers. Hy-Vee is a large supermarket chain in the Midwest with 230 locations throughout eight States (IA, IL, KS, MN, MO, NE, SD, and WI). During this public awareness/educational campaign, a total of 241,000 bag stuffers were developed, paid for and distributed by Hy-Vee. A goal of the State is to continue the partnership and possibly expand awareness efforts about effects of prescription medicines through the supermarkets' pharmacies.

DROWSY DRIVING PREVENTION WEEK

Every year at the end of Daylight Saving Time, NSF begins Drowsy Driving Prevention Week to raise awareness and educate the public regarding drowsy driving–its dangers and how to avoid it.

NHTSA

NHTSA is currently working to develop and test effective messages. Material incorporating these messages will be ready for use by State and local constituents in 2017.

FDA

The Food and Drug Administration's Safe Use Initiative Team has provided funding to the Traffic Injury Research Foundation to conduct a two-year study to develop innovative methods to better understand and reduce the occurrence of adverse events in the post-market use of drugs. In particular, it addresses the development of an evidence-based educational resource using innovative messaging strategies and mobile technologies to inform a cross-section of healthcare professionals about effective ways to communicate to patients the risks associated with operating a motor vehicle in conjunction with prescribed drugs. The expected benefits of the project include improved communication between healthcare professionals and patients, and ultimately an increased level of road safety.

SLEEP AND PUBLIC HEALTH

The Sleep Research Society has teamed up with the American Academy of Sleep Medicine and the Centers for Disease Control and Prevention to form the National Healthy Sleep Awareness Project (NHSAP). The long-term goal of the NHSAP is to promote improved sleep health in the United States. The project will increase public awareness of the importance of healthy sleep. NHSAP has developed an "Awake at the Wheel" campaign to increase awareness of the dangers of drowsy driving to the general public.

COLLEGE STUDENT EDUCATION

Sleep 101 is a novel and far-reaching approach to addressing healthy sleep in college students. Developed jointly by Healthy Hours, the educational arm of Start School Later, and the Sleep Health Institute at Brigham and Women's Hospital, this brief, self-guided online program incorporates videos, animations, and games relevant to college life so that students see how sleep affects physical and mental health, safety, and performance in and out of the classroom. Several activities target drowsy driving specifically, including a test of reaction times, a game about ways to avoid drowsy driving, and a drowsy driving video. Designed to be part of pre-freshmen orientation activities, this one-hour course fits well into any existing suite of health and wellness programming, such as alcohol education and sexual assault programs for incoming students. Sleep 101 was piloted at a handful of schools in the summer and fall of 2016, with a target date of fall 2017 for full implementation.

SLEEP PHYSICIANS

The American Academy of Sleep Medicine is creating an electronic Frequently Asked Questions document for their member board certified sleep physicians, primary care physicians, and occupational medicine physicians to help them manage Commercial Motor Vehicles Operators (CMVO) with Obstructive Sleep Apnea (OSA) and the regulatory issues they face. This FAQ will address a number of key questions and issues that sleep specialists must address when caring for a CMVO with OSA.

DRIVER EDUCATION AND TEENS

This year, DriveitHOME™, an NSC resource for parents of new teen drivers, added "Drowsy Driving" as a teen driver risk. The new drowsy-driving page on DriveitHOME.org includes information on the risks of teens' drowsy driving as well as how parents can address the issue with their teen.

Currently, 47 States and Washington, DC, have information about drowsy driving in their driver's manuals, and 17 States include drowsy-driving education in their driver's education curricula. However, the quality of the information varies widely.

The AASM Sleep and Transportation Safety Awareness Task Force has developed driver's manual language, a model curriculum, and exam questions to improve States' accuracy and consistency of their drowsy-driving content. As of this report, Alaska, California, Illinois, Indiana, Nebraska, South Carolina, and Virginia have indicated they will include the language in their manuals. AASM will continue to contact States about including the template language in their manuals.

AASM is also working to support victims' advocates. The emotionally impactful experiences that victims of drowsy driving are able to share make a strong and lasting impact on audiences.

VEHICLE TECHNOLOGY

A number of vehicle and equipment manufacturers have developed technology that detects variations in driver behavior or physiology and provides a drowsiness or attention warning. Recent NHTSA research also indicates that vehicle-based algorithms can detect drowsiness and predict lane departures. However, improved understanding of human factors issues regarding such devices is needed, especially driver response to various types of warning signals and analysis of the effectiveness of such devices in leading to appropriate driver actions and prevention (e.g., getting needed rest before continuing a trip).

Direct detection of drowsiness or other indicators of inattention are not the only way to help prevent drowsy-driving crashes. Some of the consequences of drowsy driving may be addressed through Advanced Driver Assistance Systems (ADAS), such as forward collision warning, lane departure warning, automatic emergency braking, and other systems.

FOUNDATIONS OF DROWSY DRIVER FEEDBACK

To understand the current state of drowsiness detection and alerting systems, as well as the future of these systems, NHTSA recently began work with Westat, Inc. and the University of Iowa on a project that is exploring currently available drowsiness detection and alerting systems. NHTSA is working with original equipment manufacturers (OEMs), suppliers, and aftermarket producers to discuss the function, testing, and future of drowsy driving detection systems. Additionally, NHTSA is working to develop a methodology to help determine what vehicle warnings and messages can be effective in preventing drowsy driving. Currently, OEM drowsy driving detection systems alert drivers that they are drowsy with simple warnings (e.g., a red coffee cup icon). It is unclear whether these cues are sufficient to affect an immediate remedy (e.g., stopping to rest) or longer-term behavior change (e.g., adoption of an adequate sleep pattern). To determine what type of alerting strategy is most effective, a methodology that will allow in-vehicle alerts and messages to be tested in motivationally and emotionally valid environments is being developed (e.g., the driver returning home after a long drive).

VEHICLE TECHNOLOGY ADOPTION AND EDUCATION

NSC advocates for installation of advanced safety technologies in cars, in addition to voluntary industry agreements among manufacturers to install them. Additionally, MyCarDoesWhat has partnered with the National Automobile Dealership Association (NADA) to provide educational material to U.S. dealerships and with the American Association of Motor Vehicle Administrators (AAMVA) to ensure the education material will be made available in DMVs around the country.

MyCarDoesWhat has a variety of material that teaches drivers about drowsiness alerts – for example, a feature that tracks driver movements and alerts them after recording lane weaving, as well as associated lane departure warning and lane keeping assist features. The associated educational assets in the campaign include video animations, videos filmed with real-life actors, long-form infographics, short-form graphics, Q&A's, webpages, and quiz questions. The campaign's material and public-facing presence are dynamic, allowing interaction and questions from drivers about drowsy-driving mitigating technologies.

AUTOMATED TECHNOLOGIES AND VEHICLES

U.S. DOT and NHTSA recently issued the *Federal Automated Vehicles Policy* for the safe and rapid development of advanced automated vehicle safety technologies. With the potential to transform personal mobility and to open doors to people and communities – people with disabilities, aging populations, and car sharing in communities where car ownership is prohibitively expensive — advanced vehicle technology has the potential to address virtually all human factors risks, including drowsy driving.

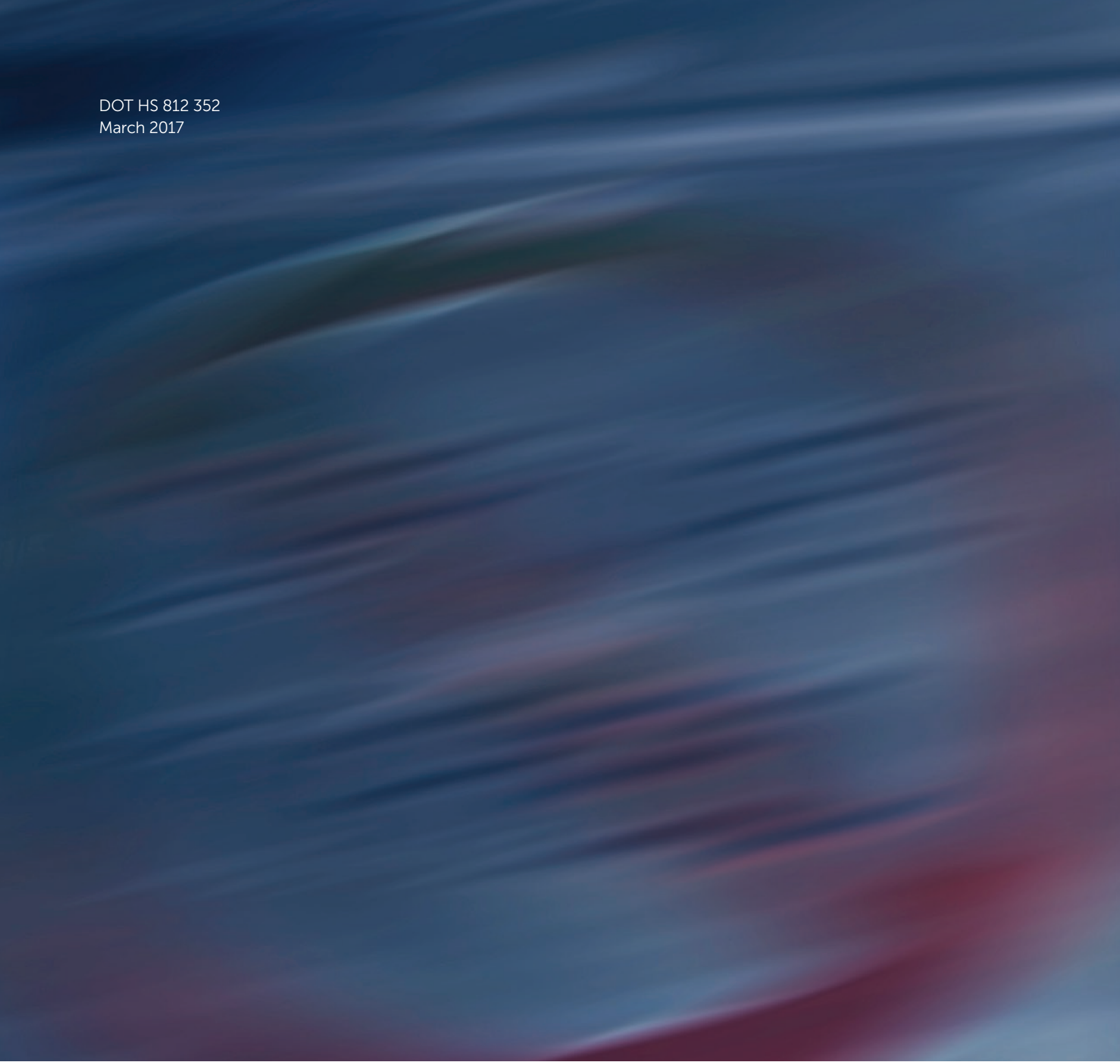
PARTNERSHIPS AND FUTURE COORDINATION

Drowsy driving is not a new highway safety issue, but it is a problem that has not received the attention it demands. The societal harm of drowsy-driving crashes, estimated at an annual cost of $109 billion, justifies a significant effort toward its prevention. Putting this into perspective, the cost of drowsy-driving crashes represents about 13 percent of the total $836 billion in societal costs of traffic crashes. Other significant sources of cost are alcohol (28%), speeding (24%), and distraction (15%). The future of drowsy-driving prevention relies on substantial partnership to continue beyond the work of the many involved partners. Together, these organizations have made significant initial progress on many of the goals outlined above, but there is still much work to do. While the U.S. Department of Transportation has the capacity to perform some of the work called for in this plan, the broad scope of the work required to address the issue requires significant participation and support from a wide range of sources, private and public.

NHTSA is dedicated to establishing more collaboration between government agencies involved in safety, health, labor, and defense to address this issue. The partners listed in this compendium will continue to meet with one another and encourage new groups to join our efforts to eliminate drowsy driving. Collectively we will focus on addressing the needs outlined in this document as well as identifying new needs that, if addressed, will impact the prevalence of drowsy driving across the United States. This compendium is only an initial draft of the work that is to come.

To get involved in these efforts, please contact any of the contributing organizations. Together we can eliminate drowsy driving.

DOT HS 812 352
March 2017



U.S. Department of Transportation
National Highway Traffic Safety Administration

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12723-031917-v4b